(19) Europäisches Patentamt
Eur pean Patent Office
Offic européen des brevets

(11) EP 1 033 236 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.09.2000 Bulletin 2000/36

(51) Int Cl.[7]: **B29D 30/44**, B29D 30/60

(21) Application number: **00301705.0**

(22) Date of filing: **02.03.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **03.03.1999 JP 5555299**

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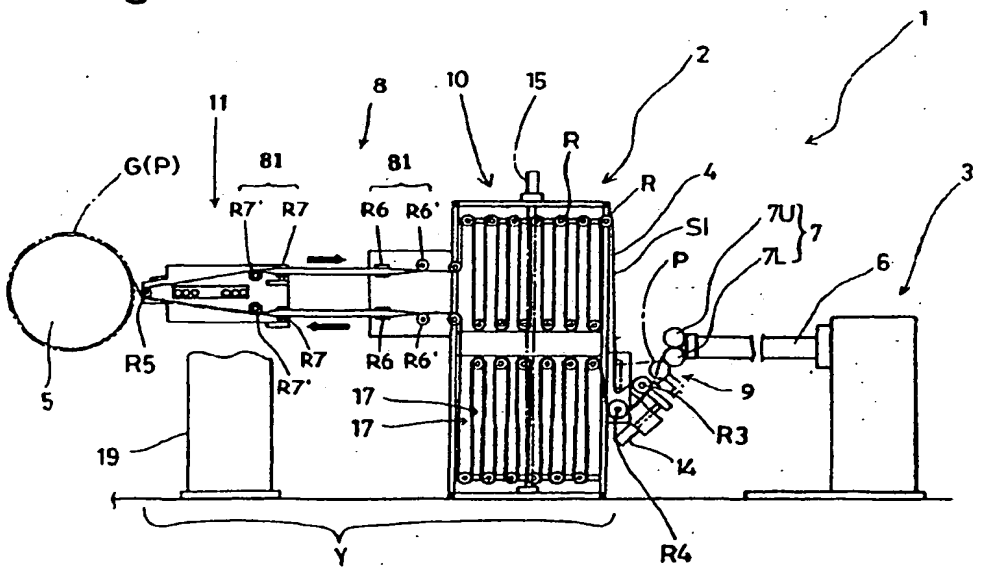
(54) Apparatus for manufacturing and delivering an unvulcanised rubber tape

(57) An apparatus for making rubber component parts such as tyre rubber parts comprises: a tape maker (3) for making an unvulcanised rubber tape (P) which comprises an extruder (6) for extruding unvulcanised rubber; a winding drum (5) around which the unvulcanisec rubber tape is wound into a rubber component part; a conveyor (2) for conveying the unvulcanisec rubber tape (P) toward the winding drum (5) which comprises a conveyor belt (4) winding around rollers and having a right side (S1) on which the unvulcanised rubber tape is put; and a traverser (11) for moving the conveyor belt (4) in the axial direction of the winding drum (5).

Fig.3



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[0001] The present invention relates to an apparatus for making rubber component parts such as tyre rubber component parts by winding an unvulcanised rubber tape, and more particularly to a conveyor for the unvulcanised rubber tape.

[0002] In a pneumatic tyre which is typical of a rubber article, as shown in Fig.11B, there are various rubber component parts (G) made of different rubber compounds, e.g. an inner liner rubber (Ga), sidewall rubber (Gb), chafer rubber (Gc), breaker cushion rubber (Gd), tread rubber (Ge), bead apex rubber (Gf) and the like.

[0003] Such rubber component parts (G) are conventionally made by means of an extruder or calender rollers in the form of a rubber strip having almost the same width as the finished width or a wide rubber sheet which is then cut to make the rubber strip. Thus, the plant and equipment become inevitably large. On the other hand, as a tyre is usually manufactured in various sizes, the total number of rubber component parts becomes very large, and accordingly it is necessary to prepare a large number of dies for the extruder. Further, it is necessary to change the facility when making a different type or size of tyre. This takes much time. Therefore, in such a conventional method, it is difficult to establish a flexible manufacturing system which is capable of satisfying various marketing needs or demands, and it is also difficult to decrease investment in plant and machinery.

[0004] Recently, in a method of making a pneumatic tyr , a method of making a rubber part has been proposed, wherein a narrow rubber tape (P) is lap-wound into a final shape of the rubber part (G) as shown in Fig. 2 for example. Machines for manufacturing such components have now, however, been entirely satisfactory.

[0005] Therefore, an object of the present invention is to provide an apparatus for making rubber component parts, which is adapted for use with such a lap-winding method and able to provide a flexible manufacturing system, while achieving downsizing of the plant and equipment and reductions in the investment in plant and machinery and the like.

[0006] According to one aspect of the present invention, an apparatus for making rubber component parts comprises at least one tape maker for making an unvulcanised rubber tape, each tape maker comprising an extruder for extruding unvulcanised rubber; a winding drum around which the unvulcanised rubber tape is wound into a rubber component part; at least one conveyor for conveying the unvulcanised rubber tape toward the winding drum, each conveyor comprising a conveyor belt winding around rollers and having a right side on which the unvulcanised rubber tape is put and a reverse side; and at least one traverser for moving the conveyor belt in the axial direction of the winding drum.

[0007] Preferably, the right side of the conveyor belt is coated with a synthetic resin so that the unvulcanised rubber tape can be secured thereon by its self-bonding property during conveying, but does not stick th reto so as to allow it to be taken off ther from when winding around the winding drum. Each conveyor preferably has an accumulator section in which the conveyor belt meanders for accumulating the unvulcanised rubber tape coming out from the tape maker, and the accumulator section having a variable capacity. Further, each conveyor has a swing section between the accumulator section and the traverser, in which the conveyor belt is twisted so that the widthwise direction of the conveyor belt is substantially at a right angle with respect to the traversing direction of the traverser.

[0008] Embodiments of the present invention will now be described in detail in conjunction with the accompanying drawings:

Figs.1A-1F show cross sectional shapes of examples of the unvulcanised rubber tape;
Fig.2 is a cross sectional view for explaining a rubber tape wound into a specific shape of a rubber component part;
Fig.3 is a schematic side view for explaining an apparatus for making rubber component parts according to the present invention;
Fig.4 is a schematic plan view of Fig.3;
Fig.5 is a schematic side view for explaining an accumulator section of a conveyor for the unvulcanised rubber tape;
Fig.6 is a schematic side view for explaining another example of the accumulator section;
Fig.7 is a schematic perspective view showing a twisted portion of a conveyor belt of the conveyor;
Fig.8 is a schematic side view for explaining a sticking means for the unvulcanised rubber tape;
Fig.9 is a schematic side view showing another example of the traverser;
Figs.10A and 10B are diagrams for explaining a cutting means for the unvulcanised rubber tape;
Fig.11A is a cross sectional view of a pneumatic tyre in which windings of the rubber tape in each tyre rubber component part are depicted; and
Fig.11B is a cross sectional view of the same pneumatic tyre.

[0009] According to the present invention, an apparatus 1 for making rubber component parts comprises at least one tape maker 3 for making a unvulcanised rubber tape P, a winding drum 5 around which the rubber tape P is wound, and at least one conveyor 2 for conveying the rubber tape P from the tape maker 3 to the winding drum 5.

[0010] In this embodiment, the apparatus 1 is incorporated in a manufacturing system for a pneumatic tyre T. Incidentally, as shown in Fig.11A, a pneumatic tyre T comprises various rubber component parts G, .g. inner liner rubber Ga, sidewall rubber Gb, chafer rubber Gc, breaker cushion rubber Gd, tread rubber Ge, bead apex rubber Gf and the like, and reinforcing members, e.g.

cord pli s such as a carcass A1 and belt (breaker) A2, and bead cores A3 and the like. Th refore, at least one of such tyre rubber component parts G is formed by winding an unvulcanised rubber tape P.

[0011] The rubber tape P usually and preferably has a thickness of from 0.2 to 2.0 mm and a width of from 10 to 50 mm. But, it may be possible to set the sizes out of these ranges according to the final shape and size of the rubber component part G.

[0012] On the other hand, as shown in Figs.1A-1F, the rubber tape P may have various cross sectional shapes, e.g. the shape may be a rectangle, a trapezoid, a rhombus and the like, and a fin or thinner portion may be provided along each edge (Fig.1B, Fig.1E) or one edge (Fig.1F) of the tape.

[0013] As shown in Fig.3 and Fig.4, the apparatus 1 in this embodiment comprises plural sets, for example four sets of a tape maker 3 (3a-3d) and a conveyor 2 (2a-2d) so as to be able to supply and wind plural rubber tapes P made of different compounds at the same time.

[0014] The tape maker 3 comprises an extruder 6 for extruding unvulcanised rubber and a pair of counterrotating compression rollers 7U and 7L.

[0015] The extruder 6 is provided in its main body with a screw for mixing rubber materials put in the main body and pushing the compounded rubber towards a die. The die is disposed at the front end of the main body and has an extruding hole from which the rubber is extruded. In this example, the shape of the extruding hole is a rectangle independently of the cross sectional shape of the rubb r tape P.

[0016] The compression rollers 7U and 7L are disposed such that the axes thereof are parallel with each other and a gap is formed therebetween in order to compress and shape the extruded rubber into a form of tape having a specific cross sectional shape as explained above. The shape of the gap is similar to but somewhat smaller than the target cross sectional shape of the rubber tape P. In this example, the compression rollers 7U and 7L are disposed near and upward and downward of the extruding hole of the die to receive the extruded rubber directly from the extruder 6, and the axes of the upper roller 7U and lower roller 7L are substantially horizontal so that the widthwise direction of the rubber tape P coming out therefrom becomes substantially horizontal.

[0017] In the case of a cross section having a flat base as shown in Fig.1A-Fig.1F, one of the compression rollers 7U and 7L, in this example the upper compression roller 7U, has a straight configuration. The configuration of the other roller 7L is changed according to the required cross sectional shape of the rubber tape P.

[0018] The above-mentioned drum 5 can be rotated around its axis by means of a computer controlled rotary actuator such as electric motor. The axis of the drum is substantially horizontal, and the drum 5 may hav a specifically profiled surface or a simple surface of a constant diameter, around which the rubber tape P is wound as the drum rotates. In this mbodiment, the drum 5 is a tyre building drum which is expandable from a cylindrical shape to a barrel-like specific shape.

[0019] The drum 5 is situated at a distance from the tape maker 3, and the conveyor 2 is dispose therebetween.

[0020] The conveyor 2 comprises an endless conveyor belt 4 which loops between the tape maker 3 and the drum 5, and various rollers R for guiding and/or driving the conveyor belt 4.

[0021] The conveyor belt 4 is made of a substantially nonextensible material (in this example polyester) and has a right side S1 and a reverse side S2. At least the right side S1 is coated with a synthetic resin (in this example a polyurethane resin) to obtain a proper adhesion to the unvulcanised rubber tape P. It is also possible to coat the reverse side S2 with the same resin.

[0022] Thus, the rubber tape P can be held on the right side S1 of the conveyor belt 4 by the self-bonding property of the tape P itself.

[0023] The conveyor 2 is made up of the following functionally different sections: a rubber-tape receiving section 9; an accumulator section 10 wherein the conveyor belt 4 meanders; a traverser section 11 wherein the conveyor belt 4 can move in the axial direction F of the drum 5 (or traversing direction); and a swing section 8 between the accumulator section 10 and traverser section 11 in which the conveyor belt 4 is twisted so that the widthwise direction thereof becomes generally crosswise to the traversing direction.

[0024] The accumulator section 10 includes a rubber-tape accumulator 10A for the rubber tape P and optionally a conveyor-belt accumulator 10B for the conveyor belt 4 returning from the drum 5.

[0025] Fig.5 and Fig.6 each schematically show an example of the accumulator section 10.

[0026] In the rubber-tape accumulator 10A, the conveyor belt 4 winds zigzag between upper free (i.e. non-driven) guide rollers R1U and lower free guide rollers R1L. Similarly, in the conveyor-belt accumulator 10B, the conveyor belt 4 winds zigzag between upper free guide rollers R2U and lower free guide rollers R2L.

[0027] In the example shown in Fig.5, the lower guide rollers R1L are fixed to a fixed frame member 13B of a main frame 12 in a horizontal line, and the upper guide rollers R2U are fixed to a fixed frame member 13C of the main frame 12 in a horizontal line. The upper guide rollers R1U are fixed to a movable frame member 13A in a horizontal line and the lower guide rollers R2L are also fixed to the same movable frame member 13A in a horizontal line. The number of the upper guide rollers R1U is equal to the number of the lower guide rollers R2L.

[0028] The movable frame member 13A is supported by a linear motion guide fixed to the main frame 12 and can be moved in the vertical direction by means of a computer controlled electric motor 15.

[0029] Accordingly, when the frame member 13A

moves upward, th accumulation in th rubber-tape accumulator 10A increases, but the accumulation in the conveyor-belt accumulator 10B decreases. On the other hand, when the frame member 13A moves downward, the accumulation in the rubber-tape accumulator 10A decreases, but the accumulation in the conveyor-belt accumulator 10B increases. The amount of increase is equal to the amount of decrease in anytime.

[0030] In the example shown in Fig.6, the upper guide rollers R1U are fixed to a fixed frame member 30A of a main frame 12 in a horizontal line, and the upper guide rollers R2U are fixed to a fixed frame member 30B of the main frame 12 in a horizontal line.

[0031] The lower guide rollers R1L are fixed to a movable frame member 31A in a horizontal line, and the lower guide rollers R2L are also fixed to a movable frame member 31B in a horizontal line.

[0032] The movable frame members 31A and 31B are respectively supported by linear motion guides, which are for example fixed to the main frame 12, movably in th vertical direction, and a downward force is applied to the frame members 31A and 31B individually utilising its own weight, and/or a spring means. In order to aid the upward and downward motion of the frame member 31A, 31B, a pressure cylinder 15 and the like may be used, but in this example, such active means is not used. Therefore, according to the difference in the length of the conveyor belt between pull-out by the drive rollers and entering into the accumulator section, the movable frame members 31A and 31B move to change the accumulation.

[0033] The consumption rate of the rubber tape P in the winding drum 5 varies widely. The rubber-tape accumulator 10A can absorb such variation. Therefore, the tape maker 3 can produce the rubber tape P at an almost constant production rate. As a result, stability of the cross sectional shape and dimensions of the tape are maintained. Further, it becomes unnecessary to extrude a mass of rubber in a short time. Thus, a relatively small extruder can be used, which also helps to render the facility size small.

[0034] Further, the rubber-tape accumulator 10A is provided near the extruder 6 and functions as a cooler for the extruded unvulcanised rubber, whereby the rubber tape P cools down before being wound and thus dimensional stability of the rubber component can be improved.

[0035] The rubber-tape receiving section 9 is provided on the tape-maker side of the accumulator section 10. This section 9 includes a receive roller R3 around which the conveyor belt 4 coming out from the accumulators 10A and 10B loops. The receive roller R3 can shift from a normal position to a pick-up position Q to pick up the rubber tape P from the compression roller 7L and position it on th conveyor b lt 4. At the normal position, th conv yor belt 4 is a certain distanc from the lower compression roller 7L, but at the pick-up position Q, the conveyor belt 4 substantially contacts with the lower compression roller 7L. In ord r to ensure the picking-up, adhesion to the rubber tape P the apparatus is arranged such that the lower compression roller 7L is smaller than the conveyor belt 4 but larger than the upper compression roller 7U. As a means 14 for shifting the receive roller R3, a reciprocating means such as a pressure cylinder, a tilting means utilising a rotary actuator, and the like may be used. In this embodiment, a reciprocating means is used.

[0036] Further, downstream of the receive roller R3, a drive roller R4 is disposed. The drive roller R4 moves the conveyor belt 4 continuously at a substantially constant speed when the tape maker 3 is producing the rubber tape P.

[0037] The above-mentioned traverser section 11 includes a traverser 22 confronting the surface of the drum 5 on which the rubber tape P is wound. The traverser 22 is supported by a pair of parallel guide shafts 21 movable therealong. The guide shafts 21 extend parallel to the axial direction F of the drum 5 and the traverser 22 can traverse the winding area W1 of the drum 5.

[0038] In this embodiment, the traversers 22a-22d of all the conveyors 2a-2d are supported by the same guide shafts 21 the ends of which are fixed to side plates 20 standing on a table 19.

[0039] Each traverser 22 (22a-22d) is moved individually by a reciprocating means 23. In this embodiment, a ball screw is utilised. Thus, each reciprocating means 23 comprises a ball nut mounted on the traverser 22 (22a-22d), a screw shaft 24 (24a-24d) engaging with the ball nut, and a computer controlled electric motor M (Ma-Md) for rotating the screw shaft 24 (24a-24d) for example mounted on the side plate 20. As the traversers 22a-22d are supported by the same guide shafts 21, a holding area W2 in which the traversers 22a to 22d can stay is provided on at least one side, preferably each side of the winding area W1. The capacity of the holding area W2 is set at least the number of all the traversers minus one. Thus, each of the traversers 22a to 22d can move across the entire width of the winding area W1 by the operation of the motor M.

[0040] Each traverser 22 is provided with a front-end roller R8, around which the conveyor belt 4 coming out from the accumulators 10A and 10B loops, and from which the rubber tape P is released towards the winding drum 5. The front-end roller R8 has a relatively small diameter such that, when the conveyor belt turns thereabout, the rubber tape P does not accompany the conveyor belt 4 due to it own rigidity, and thus separates therefrom by itself. It is however also possible to provide a positive separating means. In the example shown in Figs.3 and 8, the front-end roller R8 is a drive roller R5 which can move the conveyor belt 4 synchronously with the rotation of the drum 5. In Fig.8, the rubber tape P is released from the downside of the front-end roller R8, but it is also possible to construct the trav rs r 22 such that the rubber tape P is released from the upside of the front-end roller R8.

[0041] Further, each traverser 22 is provided with a sticking means 26 for pressing the rubb r tape P onto the surface of the winding drum 5 or previously wound materials. The sticking means 26 comprises a reciprocating means 26A mounted on the traverser 22 and having a rod which can protrude towards the winding drum 5, and a pressing roller 26B which is a free roller disposed at the tip of the rod. The surface of the pressing roller 26B is smooth and coated with a synthetic resin to which the unvulcanised rubber is hard to adhere. Thus, the pressing roller 26B can smooth the reverse side of the rubber tape P even if it has been roughed when separating from the conveyor belt 4.

[0042] Furthermore, a tape cutter 40 which can cut the rubber tape P during transporting is provided downstream of the accumulator section 10, for example provided on each traverser 22. The tape cutter 40 comprises a moving blade 42 which can move at the same blade velocity as the transporting speed of the rubber tape P and a pusher which relatively pushes the rubber tape P towards the moving blade 42. In the example shown in Fig.10A and Fig.10B, the pusher comprises an actuator 43 such as pressure cylinder anti the like and a pushing plat 41 fixed to a rod of the actuator 43. The moving blade 42 is a rotary blade rotated by a motor 44. When cutting the rubber tape P, by the operation of the actuator 43, the pushing plate 41 pushes the reverse side S2 of the conveyor belt 4 to a position where the moving blade 42 reaches to the right side S1 of the conveyor belt 4. At the same time, the rotary blade 42 is rotated such that the relative speed between the blade velocity and the transporting speed becomes zero. Thus, the rubber tap P can be cut during moving.

[0043] In order to prevent the rubber tape P on the conveyor belt 4 from moving or slipping out of position, the conveyor belt 4 is preferably decreased in the total length of parts in which the widthwise direction of the conveyor belt 4 is not parallel with the horizontal direction. Thus, in the above-mentioned accumulator section 10 and rubber-tape receiving section 9, the conveyor belt 4 winds such that the widthwise direction becomes parallel with the horizontal direction. In the traverser section 11, the widthwise direction of the conveyor belt 4 is usually horizontal although it may be inclined when the rubber tape P must be wound around the drum with a relatively large inclination angle.

[0044] The above-mentioned swing section 8 is provided between the traverser section 11 and the accumulator section 10.

[0045] In the swing section 8, the conveyor belt 4 is twisted once (about 90 degrees) near the accumulator section 10 so that the widthwise direction becomes at a right angle with respect to the traversing direction, and again the conveyor belt 4 is twisted (about 90 degrees) near th traverser section 11 so that the widthwis direction again b comes horizontal. Thereby, the conveyor belt 4 enters and goes out the swing section 8 whilst maintaining the widthwise direction horizontal on both the trav rser side and the accumulator side.

[0046] In order to twist as above, the swing section 8 includes two sets of twisting rollers (R6 and R6') and (R7 and R7'), each set including: a pair of substantially orthogonal rollers 81 including a vertical roller R7 and a horizontal roller R7' mounted on the traverser 22; and a pair of substantially orthogonal rollers including a vertical roller R6 and a horizontal roller R6' mounted on the main frame 12 of the accumulator, wherein the widthwise direction of the conveyor belt 4 between the vertical roller R6 and R7 is right angles to the traversing direction or horizontal direction. With respect to the traversing direction, the vertical roller R6 on the accumulator side is disposed outside the winding area W1 and the conveyor belt 4 runs on the outside of the vertical roller R6, whereby the traverser 22 can move across the entire width of the winding area W1. By providing the swing section 8, it becomes possible to increase the inclination angle of the conveyor belt 4 during traversing. As a result, the distance Y between the accumulator section and the traverser section can be shortened, and a plurality of traversers 22 can be arranged in a narrow space near the winding drum 5.

[0047] It is not always necessary but preferable to prevent the rubber tape P on the conveyor belt 4 from contacting with the various rollers R. Therefore, in this embodiment, the conveyor belt 4 is twisted between adjacent rollers R.

[0048] For example, in the above-mentioned rubber-tape accumulator 10A, the conveyor belt 4 is twisted 180 degrees between the upper guide rollers R1U and the lower guide rollers R1L. On the other hand, it is not always necessary to twist the return portion of the conveyor belt 4 on which the rubber tape P does not exist. But in order to prevent the rollers R from being stained with fragments of unvulcanised rubber, the conveyor belt is preferably twisted in the same manner as above. Therefore, in the conveyor-belt accumulator 10B in this embodiment, the conveyor belt 4 is also twisted 180 degrees between the upper guide rollers R2U and the lower guide rollers R2L. Further, various parts, for example between the drive roller R4 and the first guide roller R1U of the rubber-tape accumulator 10A are twisted. Accordingly, only the reverse side S2 of the conveyor belt 4 contacts with the rollers R.

[0049] In the traverser section 11, it is not always necessary to support all the traversers 22a-22d by the same guide shafts 21.

[0050] In Fig.9, each traverser 22 is supported individually by parallel guide shafts 21. In this case, the traversers 22 are located in circumferentially different positions around the axis of the drum 5 so that the traversers 22 can move without coming into collision with each other. Thus, the freedom of the traversers' movements is greatly incr ased.

[0051] Fig.9 further shows another example of the traverser 22, wherein a front-end roller R8 thereof is mounted on a frame 30 which can lean towards the

winding drum 5, and a driving roller R5 is separately provided downstream of the front-end roller R8. Thus, by the rotation of the driving roller R5, the conv yor belt 4 is pulled, and by the tension thereof, the frame 30 I ans such that the front-end roller R8 contacts with the winding drum 5. Thus, it is possible to apply the rubber tape P onto the winding drum 5. Thus, the front-end roller R8 also has the function of the above-mentioned pressing roller 26B, and the pressing roller 26B is omitted.

[0052] The apparatus 1 further comprises a controller including a programmable computer, which controls the above-mentioned various actuators, motors, cylinders and the like according to a stored program and output data of various speed detectors and sensors which are connected to the computer:

to rotate the drive roller R4 in each rubber-tape receiv-ng section 9 to move the conveyor belt 4;
to rotate the compression rollers 7U and 7L;
to rotate the screw in each extruder 6;
to move each receive roller R3 to approach to the compression roller 7L;
to move the receive roller R3 to depart from the compression roller 7L when the coming out of the rubber tape P and the receiving thereof are detected by sensors;
to rotate the driving rollers R5 until the rubber tape P comes to the front-end roller R8;
to move the traversers 22 (22a-22d) so that ends of the rubber tapes position on the predetermined wind-starting positions;
to rotate the winding drum 5 to wind the rubber tapes P therearound while moving the traversers 22 (22a-22d) at predetermined variable speeds and directions so that each of the rubber tapes is wound into a target cross sectional shape;
to move the movable frame member 13A in the accumulator section 10 according to the difference between the supply and demand;
to cut the rubber tapes P and stop the driving rollers R5 when the counted number of windings and the detected thickness of the windings reach to precept values.

[0053] In the case of the pneumatic tyre T shown in Fig.11A, on a cylindrical surface of the drum 5, a thin inner liner rubber Ga is formed in the centre of the drum 5, and a chafer rubber Gc is formed on each side of the inner liner rubber Ga, and a sidewall rubber Gb is formed on the axially outside of each chafer rubber Gc. Then, a carcass ply A1 is wound thereon. Further, on the wound carcass ply A1, a breaker cushion rubber Gd is formed on each side the centre thereof (tyre equator). These rubber component parts Ga, Gb, Gc and Gd are made by winding the unvulcanised rubber tapes Pa, Pb, Pc and Pd with the drum 5 in its contracted stat . Next, by xpanding the drum 5, the wound materials are shaped into a toroid; an annular assembly of a bead core A3 and bead apex rubber Gf is set on ach side thereof; an annular assembly of a belt A2 and tread rubber Ge is set around the crown portion of the carcass A1; the edges of the carcass are turned up around the bead cores A3 together with the chafer rubber Gc and sidewall rubber Gb; and thereby a raw tyre is formed, and lastly the raw tyre is put in a mould and vulcanised.

[0054] When the rubber tapes P are not wound around the drum 5 to carry out other operations, the conveyor belt 4 is stopped in the traverser section 11 and swing section 8. However, in the accumulator section 10, by the rotation of the drive roller R4, the conveyor belt 4 continuously moves at a substantially constant speed V1 from the conveyor-belt accumulator 10B to the rubber-tape accumulator 10A through the receiving section 9 to accumulate the rubber tape P. When the tape winding is restarted, as the rubber-tape P is accumulated in the rubber-tape accumulator 10A, the drive roller R5 is rotated at a speed V2 faster than the drive roller R4 but equal to the winding drum 5 to make the rubber component parts again as explained above.

[0055] In general, a rubber component part formed by winding a rubber tape around a drum is liable to contract when detached from the drum if the tape has a latent tension. Therefore, the transporting speed V1 of the conveyor belt 4 when receiving the tape P is controlled to be somewhat slower than (usually in a range between 0.8 and 1.0 times) the outgoing speed V0 of the rubber tape P from the tape maker 3. Thereby, latent tension can be completely eliminated from the rubber tape P in a free portion K prepared between the tape maker 3 and conveyor 2. On the other hand, the drive roller R5 is rotated synchronously with the rotation of the winding drum 5, and the speed V2 thereof is the substantially same as the circumferential velocity Vf of the winding drum 5. Thus, the contraction can be prevented. But, if necessary, the speed V2 may be varied within the range of from -2% to +3% of the speed Vf.

[0056] Further, the above-mentioned apparatus 1 may be provided with a belt-forming drum in addition to the above-mentioned the tyre building drum 5. The tyre building drum 5 has a profiled surface corresponding to the carcass profile of the finished tyre, around which belt cord plies are wound and further a rubber tape P is wound thereon to form the above-mentioned tread rubber and belt assembly.

[0057] The present invention can be applied to a method and apparatus for manufacturing various rubber components in addition to the tyre component parts.

Claims

1. An apparatus for making rubber component parts comprising at l ast one tape maker (3) for making an unvulcanised rubber tape (P), each of said at least one tape maker (3) comprising an extruder (6) for extruding unvulcanised rubber, a winding drum

(5) around which said unvulcanised rubber tape is wound into a rubber component part, at least one conveyor (2) for conveying said unvulcanised rubber tape (P) toward the winding drum (5), characterised in that each of said at least one conveyor (2) comprises a conveyor belt (4) winding around rollers (R) and having a right side (S1) on which said unvulcanised rubber tape is put and a reverse side (S2), and at least one traverser (11) for moving said conveyor belt (4) in the axial direction of the winding drum (5).

2. An apparatus for making rubber component parts according to claim 1, characterised in that the right side (S1) of the conveyor belt (4) is coated with a synthetic resin so that the unvulcanised rubber tape (P) can be secured thereon by its self-bonding property during conveying, but does not stick thereto so as to be able to take it off therefrom when winding around the winding drum (5).

3. An apparatus for making rubber component parts according to claim 2, characterised in that said synthetic resin is polyurethane.

4. An apparatus for making rubber component parts according to claim 1, 2 or 3, characterised in that each of said at least one conveyor (2) has an accumulator section (10) in which the conveyor belt (4) meanders for accumulating the unvulcanised rubber tape (P) coming out from the tape maker (3), and said accumulator section (10) having a variable capacity.

5. An apparatus for making rubber component parts according to claim 4, characterised in that each of said at least one conveyor (2) has a swing section (8) between said accumulator section (10) and the traverser (11), in which the conveyor belt (4) is twisted so that the widthwise direction of the conveyor belt (4) is substantially at a right angle with respect to the traversing direction of the traverser.

6. An apparatus for making rubber component parts according to claim 4 or 5, characterised in that said conveyor belt (4) is twisted so that the unvulcanised rubber tape (P) on the right side thereof does not contact with rollers, but the reverse side contacts with the rollers.

7. An apparatus for making rubber component parts according to any of claims 1 to 6, characterised in that between the tape maker (3) and a portion of the conveyor belt (4) receiving the rubber tape (P) coming out from the tape maker (3), there is a certain spac to allow the rubber tape to expand or contract by its internal stress, and a transporting speed of the conveyor belt (4) in said portion when receiving the rubber tap and a speed of the rubber tap coming out from the tape maker (3) are differed from each other so as to eliminate a latent stress from the rubber tape.

8. An apparatus for making rubber component parts according to any of claims 1 to 7, characterised in that a cutting means (40) is further provided for each of said at least one conveyor, the cutting means (40) comprising a cutting blade (42) which can move at a relative speed of zero to the rubber tape (P) on the conveyor belt (4) so as to cut the rubber tape (P) during transporting.

9. An apparatus for making rubber tyres including the apparatus for making rubber component parts according to any of claims 1 to 8, characterised in that the number of said at least one tape maker, the number of said at least one conveyor and the number of said at least one traverser are the same plural number, and said winding drum (5) is a single drum which can expand such that its surface around which the rubber tapes are wound can changes from a cylindrical profile to a predetermined profile.

Fig.1A

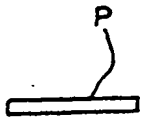


Fig.1B

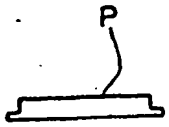


Fig.1C

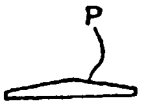


Fig.1D

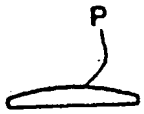


Fig.1E

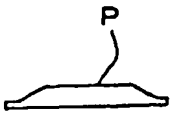
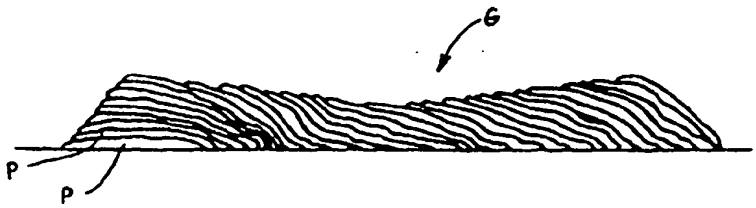


Fig.1F

Fig.2



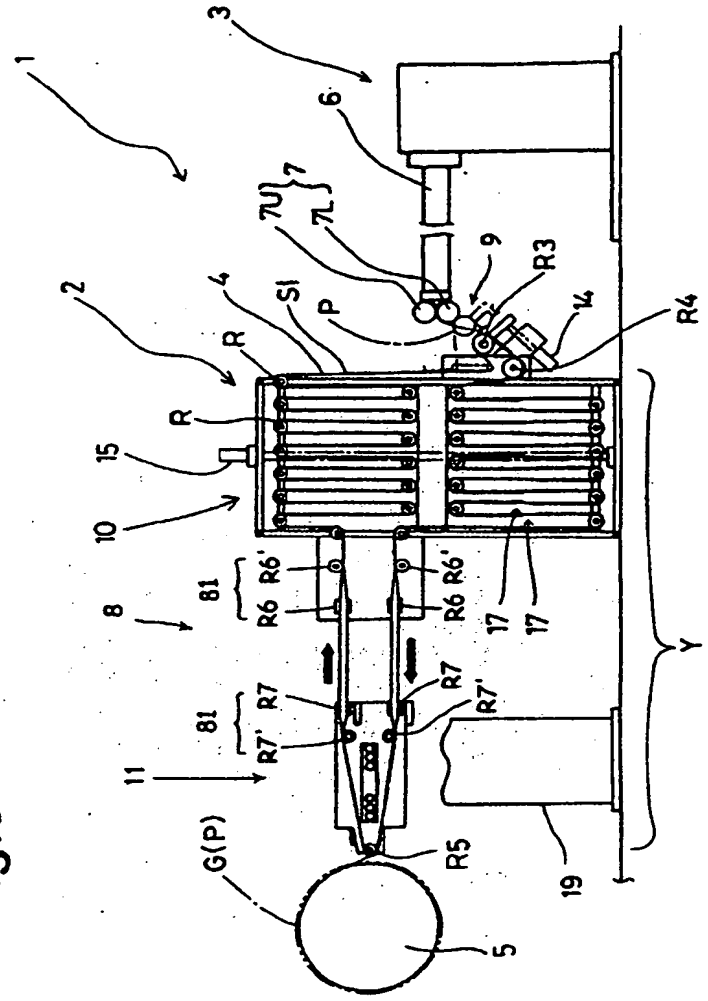


Fig.3

Fig.4

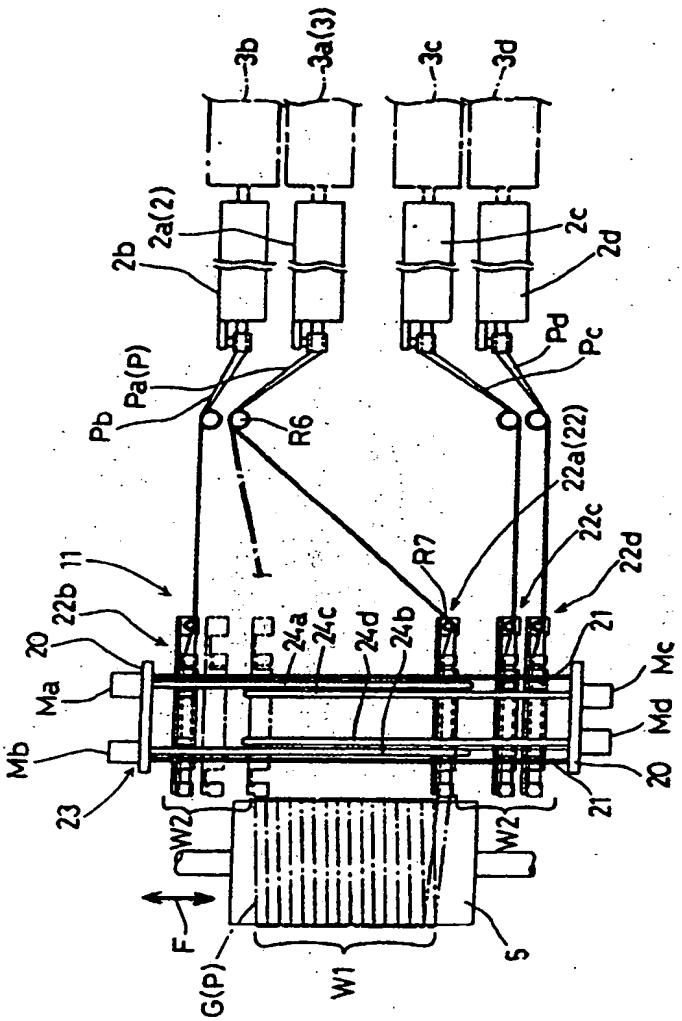


Fig.5

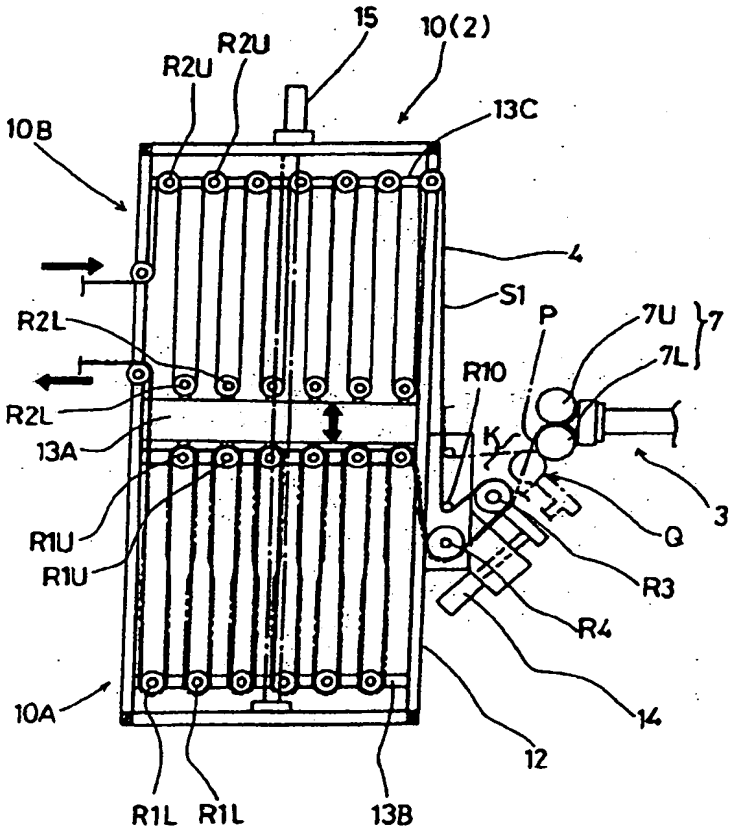


Fig.6

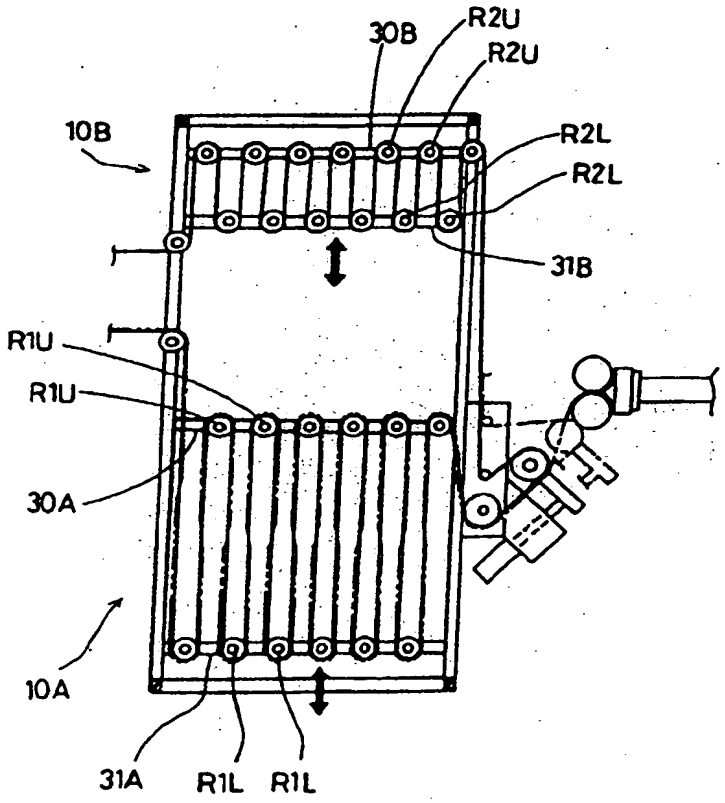


Fig.7

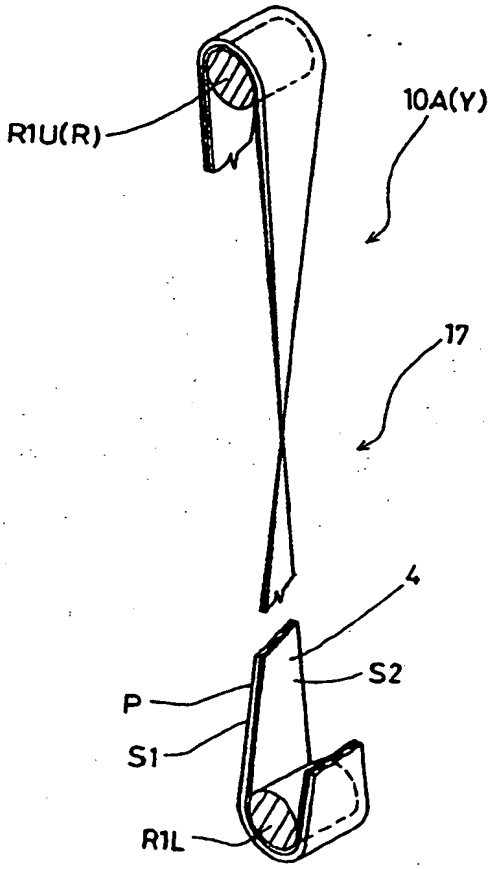
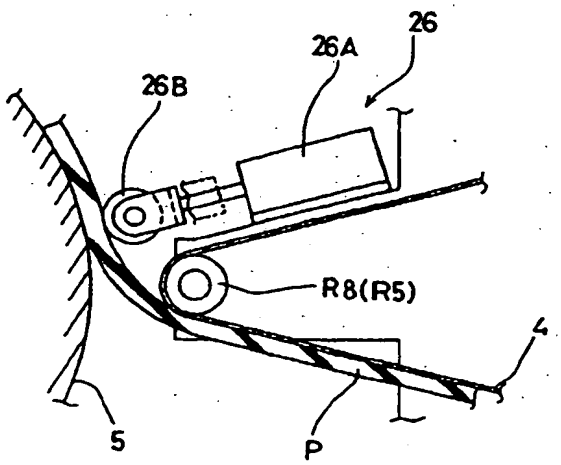


Fig.8



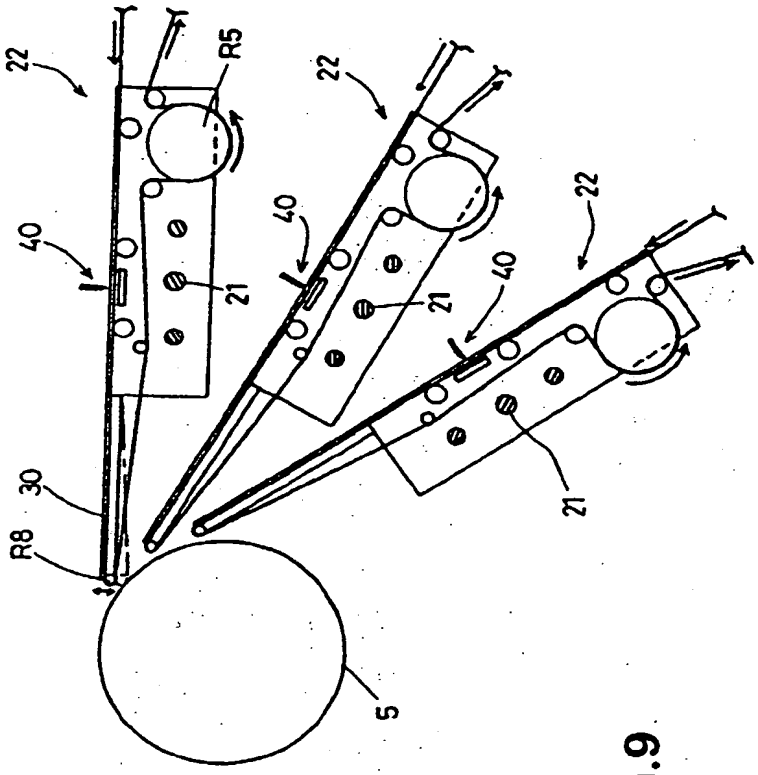


Fig.9

Fig.10B

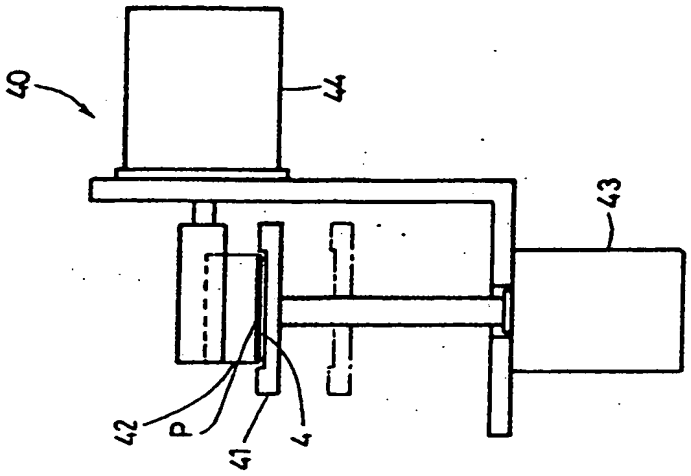


Fig.10A

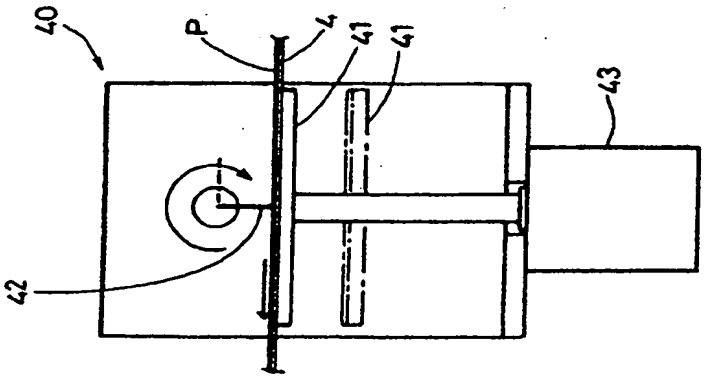


Fig.11A

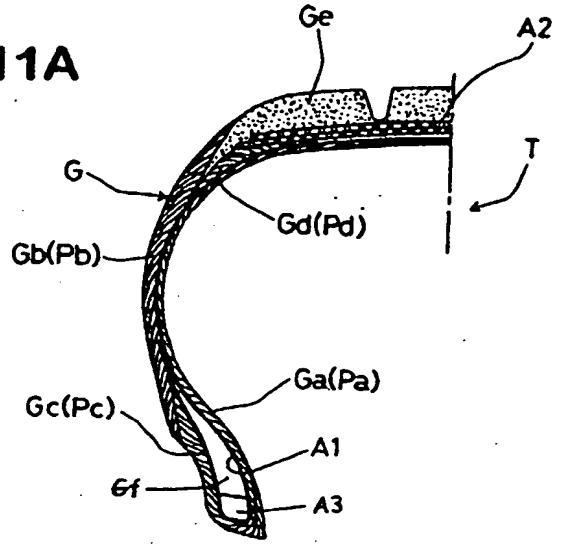
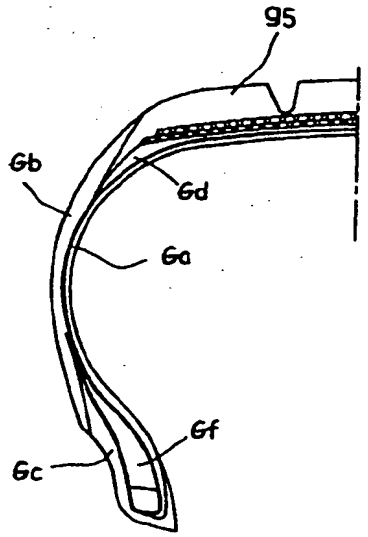


Fig.11B



(19) Europäisches Patentamt
Europ an Patent Office
Office européen des brevets

(11) EP 1 033 236 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
01.08.2001 Bulletin 2001/31

(43) Date of publication A2:
06.09.2000 Bulletin 2000/36

(21) Application number: **00301705.0**

(22) Date of filing: **02.03.2000**

(51) Int Cl.7: **B29D 30/44**, B29D 30/60, B29D 30/30, B29D 30/46

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **03.03.1999 JP 5555299**

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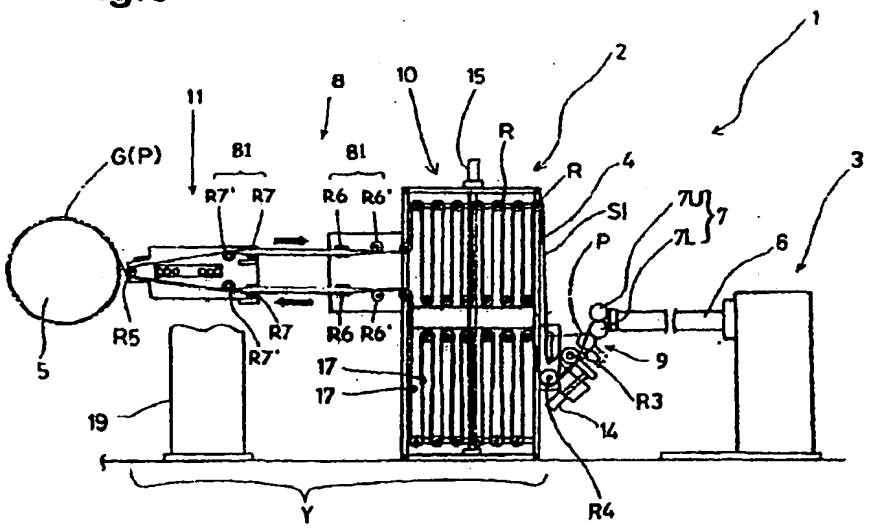
(54) Apparatus for manufacturing and delivering an unvulcanised rubber tape

(57) An apparatus for making rubber component parts such as tyre rubber parts comprises: a tape maker (3) for making an unvulcanised rubber tape (P) which comprises an extruder (6) for extruding unvulcanised rubber; a winding drum (5) around which the unvulcanisec rubber tape is wound into a rubber component part; a conveyor (2) for conveying the unvulcanisec rubber tape (P) toward the winding drum (5) which comprises a conveyor belt (4) winding around rollers and having a right side (S1) on which the unvulcanised rubber tape is put; and a traverser (11) for moving the conveyor belt (4) in the axial direction of the winding drum (5).

Fig.3



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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 1705

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X Y	US 4 240 863 A (VINTON DAVID S) 23 December 1980 (1980-12-23) * column 3, line 24 - column 5, line 1 * * figures 1,3 *	1 2-4,8,9	B29D30/44 B29D30/60 B29D30/30 B29D30/46
Y A	US 4 674 622 A (UTSUNOMIYA TADASHI ET AL) 23 June 1987 (1987-06-23) * column 1, line 5 - line 17 * * column 2, line 67 - column 3, line 28 * * figures 1,4 *	2,3 1	
A	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 11, 29 November 1996 (1996-11-29) & JP 08 192911 A (SHINETSU ENG KK), 30 July 1996 (1996-07-30) * abstract *	1,2	
A	DE 12 16 528 B (GOODRICH COMPAY) 12 May 1966 (1966-05-12) * column 1, line 1 - line 11 * * column 2, line 45 - column 3, line 10 * * figure 2 *	1,2	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B29D B65G B65H B29C
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 12, 31 October 1998 (1998-10-31) & JP 10 193475 A (YOKOHAMA RUBBER CO LTD:THE), 28 July 1998 (1998-07-28) * abstract *	1,9	
Y	WO 98 05580 A (BANAS MARK DANIEL ;CONGER KENNETH DEAN (US); LUNDELL DENNIS ALAN () 12 February 1998 (1998-02-12) * page 1, line 4 - page 3, line 18 * * figures *	4	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 May 2001	Bibollet-Ruche, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 30 1705

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 4 645 135 A (KONS HUGO L ET AL) 24 February 1987 (1987-02-24) * the whole document *	5,6	
A	US 3 523 854 A (CANTARUTTI ARMINDO) 11 August 1970 (1970-08-11) * column 2, line 35 - column 3, line 26 * * figures 1,2 *	5,6	
A	US 3 455 764 A (BRYANT EMERSON C) 15 July 1969 (1969-07-15) * the whole document *	4	
A	GB 1 152 184 A (VITAFOAM) 14 May 1969 (1969-05-14) * page 1, line 27 - page 2, line 43 * * figures 1,2 *	1,7	
Y	US 3 779 834 A (APPLEBY P ET AL) 18 December 1973 (1973-12-18) * column 1, line 11 - line 32 * * column 4, line 56 - column 5, line 58 * * column 6, line 28 - column 7, line 39 * * column 10, line 34 - line 39 * * figures *	8,9	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 5 293 795 A (INOUE SHUNICHI ET AL) 15 March 1994 (1994-03-15) * column 8, line 3 - line 27 * * figure 6 *	8	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 May 2001	Biboller-Ruche, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 00 30 1705

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-3,9

   An apparatus for making rubber component parts comprising a conveyor having a belt coated with synthetic resin

2. Claims: 4-6

   An apparatus for making rubber component parts comprising an accumulator.

3. Claim : 7

   An apparatus for making rubber component parts comprising a conveyor with a conveyor belt having a different speed from the speed of the rubber tape coming out of the tape maker.

4. Claim : 8

   An apparatus for making rubber component parts comprising a cuting means

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 30 1705

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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14-05-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4240863 A	23-12-1980	CA 1141121 A	15-02-1983
		CA 1141122 A	15-02-1983
		DE 3067311 D	10-05-1984
		EP 0017871 A	29-10-1980
		JP 55140544 A	04-11-1980
US 4674622 A	23-06-1987	NONE	
JP 08192911 A	30-07-1996	NONE	
DE 1216528 B		BE 559280 A	
		DE 1201979 B	
JP 10193475 A	28-07-1998	NONE	
WO 9805580 A	12-02-1998	AU 6844196 A	25-02-1998
		BR 9612706 A	27-07-1999
		EP 0918717 A	02-06-1999
		JP 2000515473 T	21-11-2000
		PL 331462 A	19-07-1999
		US 6215205 B	10-04-2001
US 4645135 A	24-02-1987	NONE	
US 3523854 A	11-08-1970	NONE	
US 3455764 A	15-07-1969	DE 1579298 A	13-08-1970
		GB 1098204 A	10-01-1968
		SE 312673 B	21-07-1969
GB 1152184 A	14-05-1969	NONE	
US 3779834 A	18-12-1973	NONE	
US 5293795 A	15-03-1994	JP 3117732 B	18-12-2000
		JP 4220332 A	11-08-1992
		EP 0493062 A	01-07-1992

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